BC Lake Stewardship and Monitoring Program

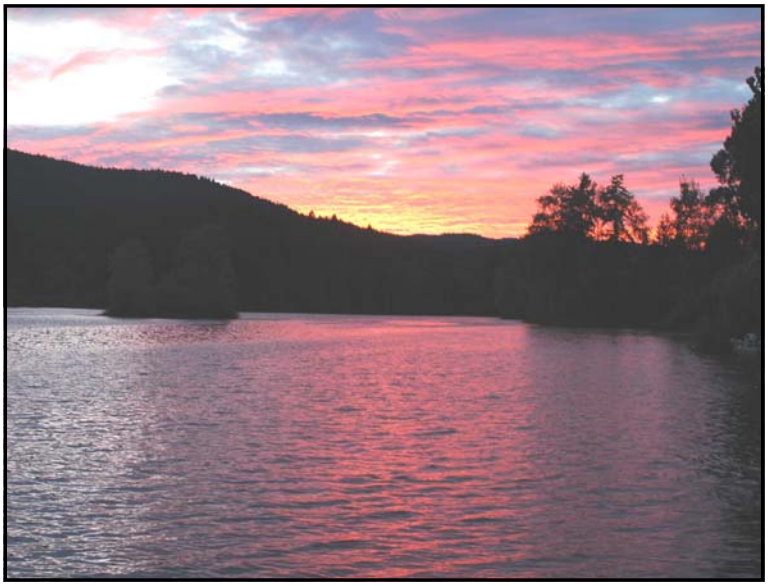
Langford Lake (1973-2004)

A partnership between the BC Lake Stewardship Society and the Ministry of Water, Land, and Air Protection

The Importance of Langford Lake & its Watershed

British Columbians want lakes to provide good water quality, aesthetics, and recreational opportunities. When these features are not apparent in local lakes, people begin to wonder why. Concerns often include whether the water quality is getting worse, if the lake has been polluted by land development or other human activities, and what conditions will result from more development within the watershed.

The BC Lake Stewardship Society (BCLSS), in collaboration with the Ministry of Water, Land, and Air Protection (MWLAP), has designed a program, *The BC Lake Stewardship and Monitoring Program*, to address these concerns. Through regular water sample collections, we can come to understand a lake's current water quality, identify the preferred uses for a given lake, and monitor water quality changes resulting from land development within the lake's watershed.



The BCLSS can provide communities with both lake-specific monitoring results and educational materials on general lake protection issues. This useful information can help communities play a more active role in the protection of the lake resource. Finally, this program allows government to use its limited resources efficiently thanks to the help of local volunteers and BCLSS.

The watershed area of Langford Lake is 3.2 km^2. A **watershed** is defined as the entire area of land that moves the water it receives into a common waterbody. The true definition represents a much larger area than most people usually consider.

Watersheds are where much of the ongoing hydrologic cycle takes place and play a crucial role in the purification of water. Although no *new* water is ever made, it is continuously filtered and recycled as it moves through watersheds and other hydrologic compartments. The quality of the water resource is largely determined by a watershed's capacity to buffer impacts and absorb pollution.

Every component of a watershed has an important function in maintaining good water quality and a healthy aquatic environment. It is a common misconception that detrimental land use practices will not impact water quality if they are not in the area immediately surrounding a water body. Poor land-use practices anywhere in a watershed can eventually impact the water quality of the downstream environment.

Human activities that impact water bodies range from small and numerous *non-point* sources to large *point* sources of concentrated pollution (e.g. outfalls, spills, etc.). Undisturbed watersheds have the ability to purify water and repair small amounts of damage from pollution and alteration. However, modifications to the landscape and increased levels of pollution impair this ability.

Langford Lake is located approximately 15 km west of Victoria on southern Vancouver Island. It is a kettle lake, formed by the melting of an isolated block of glacial ice more than 10,000 years ago following the Vashon glaciation. Langford Lake has a surface area of 61 hectares, a perimeter of 4,510 meters and lies at an elevation of 62 meters. Its mean depth is 6.4 meters and the maximum depth is 16.7 meters. Langford Lake flows from south to north through a single inflow and a single outflow to the Goldstream River. The water residence time of Langford Lake is 3.2 years.

Langford Lake - Past, Present and Future

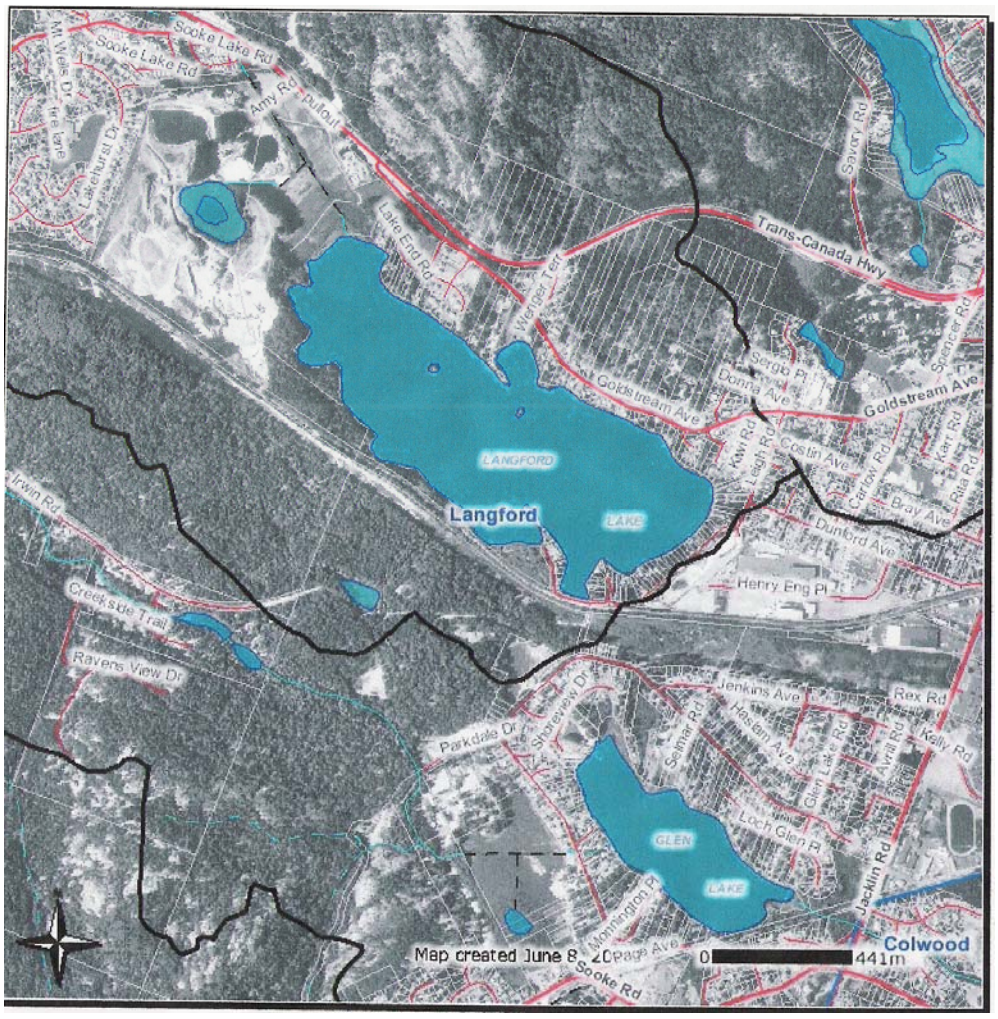
Langford Lake provides a number of significant recreational values including swimming, boating, hiking and fishing. Species of fish present in the lake include rainbow and cutthroat trout, sunfish, pumpkinseed, smallmouth bass, and yellow perch. There are trails around most of the west side of the lake and three swimming areas, including two public beaches. The lake also provides significant wildlife habitat and aesthetics for lakeshore residents.

Langford Lake originally flowed south to Esquimalt Lagoon through Glen Lake before the outlet was cut off from its natural wetlands when the E&N railway built an embankment along the western shore for its rail line. In 1932, a drainage ditch to the Goldstream River was built at the north end of the lake to prevent flooding of lakeshore homes and a culvert was installed under the railway to allow drainage from an agricultural area known as Hull's Field to south of Langford Lake. When Hull's Field became flooded, the water was actually pumped into the lake.

The majority of development is currently on the north and east shorelines of Langford Lake, however there are plans for future development, concentrating along the western shore and to the northeast on Skirt Mountain. Development of approximately 47 ha around the northwest end of the lake, known as the Goldstream Meadows, is expected to begin within the next few years. Any development taking place will include significant setbacks from the shore of the lake.

Prior to 1984, Langford Lake had high nutrient levels and consequently low oxygen levels. In an attempt to increase oxygen levels in the lake and reduce the change in temperature from surface to lake-bottom (destratify), an aerator was installed in 1984. This first aerator did not meet the oxygen consumption rate of the sediments so in 1985 a more efficient aerator was installed and has been operating ever since (Nordin and McKean, 1988).

Langford Lake Aerial Map



Map obtained from CRD Natural Areas Atlas (2005)

Non-Point Source Pollution and Langford Lake

One type of pollution, *point* source pollution, originates from municipal or industrial effluent outfalls. Other pollution sources exist over broader areas and may be hard to isolate as distinct effluents. These are referred to as *non-point* sources (NPS) of pollution. Shoreline modification, storm-water runoff, onsite septic systems, agriculture, and forestry are common contributors to NPS pollution. One of the most detrimental effects of NPS pollution is nutrient loading to water bodies.

Onsite Septic Systems and Grey Water

Onsite septic systems effectively treat human waste water and wash water (grey water) as long as they are properly located, designed, installed, and maintained. When these systems fail they become significant sources of nutrients and pathogens.

Most residents living around Langford Lake currently rely on septic tanks for sewage disposal. Municipal sewer system access is presently being extended throughout the District of Langford, with the Langford Lake area extension currently in the planning stages. If homes currently using on-site waste disposal systems are connected to new sewer mains provided with new development, it is conceivable that an improvement in water quality may be seen.

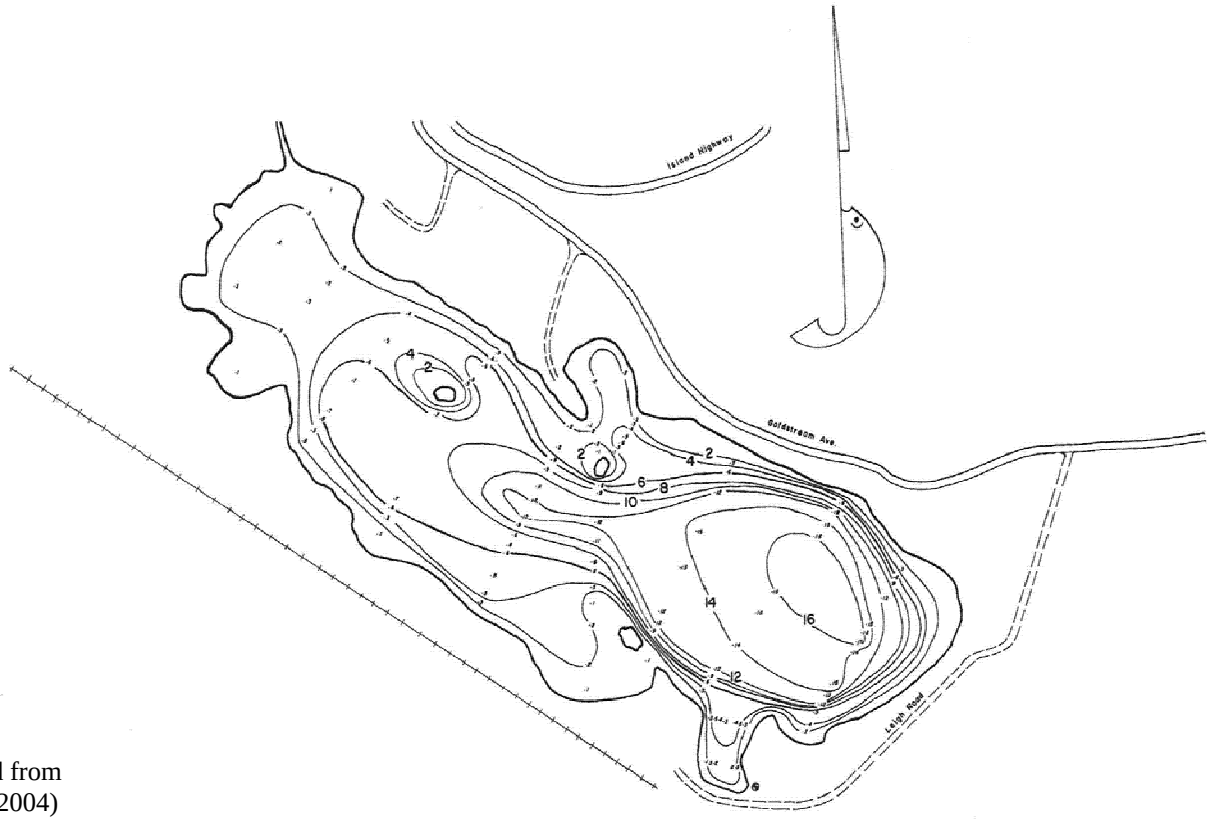
Stormwater Runoff

Lawn and garden fertilizer, sediment eroded from modified shorelines or infill projects, oil and fuel leaks from vehicles and boats, road salt, and litter can all be washed by rain and snowmelt from properties and streets into watercourses. Phosphorus and sediment are of greatest concern as they provide excess nutrients and/or a rooting medium for weedy aquatic plants and algae. Pavement prevents water infiltration to soils, collects hydrocarbon contaminants during dry weather, and increases direct runoff of these contaminants to lakes during storm events.

Boating

Oil and fuel leaks are the main concerns of boat operation on small lakes. With larger boats, noise and sewage and grey water discharges are issues. Langford Lake has an "Electric Motors Only" rule, which protects the lake from gas, oil, and other contaminants that may harm this sensitive ecosystem. Other problems associated with boating (motorized or not) include litter, the spread of aquatic plants, shoreline erosion, and the churning up of bottom sediments and nutrients

Langford Lake Bathymetric Map



Map obtained from
FishWizard (2004)

What's Going on Inside Langford Lake?

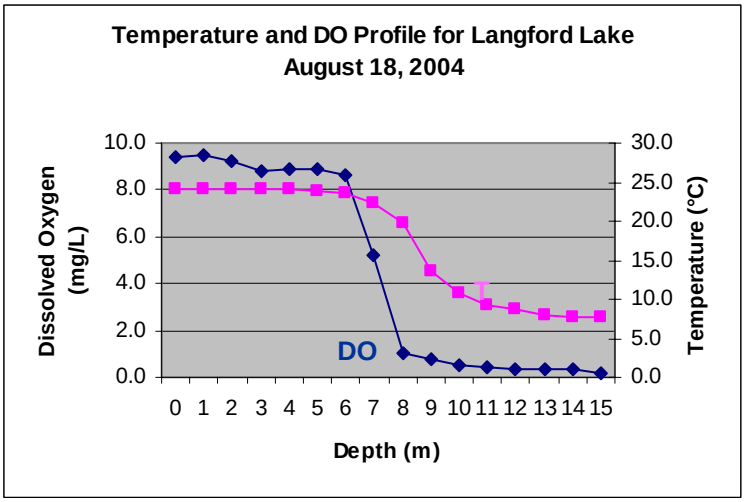
Temperature

Lakes show a variety of annual temperature patterns based on their location and depth. Most lakes in BC, including Langford Lake, form layers (stratify) in the summer, with the coldest water layer (hypolimnion) near the bottom. Because colder water is denser, it resists mixing into the warmer, upper layer (epilimnion) for much of the summer. When the warmer surface water distinctly separates from the colder water in the deeper parts of the lake, it is said to create a thermocline, a region of rapid temperature change between the two layers that is usually most pronounced in the summer.

In spring and fall, these lakes usually mix from top to bottom (overturn) as wind energy overcomes the reduced temperature and density differences between surface and bottom waters. In the winter, lakes re-stratify under ice with the densest water (4°C) near the bottom. Because these lakes turn over twice per year, they are called dimictic lakes. These are the most common type of lake in British Columbia.

Coastal lakes in BC are more often termed warm monomictic lakes. These lakes turn over once per year. Warm monomictic lakes have temperatures that do not fall below 4°C. They generally do not freeze and circulate freely in the winter at or above 4°C and stratify in the summer. Langford Lake is classified as warm monomictic.

Temperature stratification patterns are very important to lake water quality. They help determine many of the changes in dissolved oxygen, nutrients, and algal conditions. In Langford Lake, stratification typically begins in April and lasts until fall overturn in late November. During this period, the thermocline is well defined between approximately 6 and 10 metres. The following graph of dissolved oxygen and temperature readings taken in August of 2004 clearly shows the thermocline, and indicates a possibility that the fisheries habitat is limited in Langford Lake in the summer because the epilimnion layer has temperatures exceeding the upper limit of 25°C for salmonid species.



Dissolved Oxygen

Oxygen is essential to life in lakes. It enters lake water from the air by wind action and internally through plant photosynthesis. Oxygen is consumed by respiration of animals and plants, including the decomposition of dead organisms by bacteria. A great deal can be learned about the health of a lake by studying dissolved oxygen patterns and levels.

Lakes that are unproductive (oligotrophic) will have sufficient oxygen to support life at all depths throughout the year. As lakes become more productive (eutrophic), and increasing quantities of plants and animals respire and decay, more oxygen consumption occurs, especially near the bottom where organic matter accumulates.

Trophic Status

The term *trophic status* is used to describe a lake's level of productivity, which is often determined by measuring levels of total phosphorus (TP), algal chlorophyll *a* (the green photosynthetic pigment), and water clarity. Establishing the trophic condition of a lake allows general biological and chemical attributes of a lake to be estimated.

Lakes of low productivity are referred to as ***oligotrophic***, meaning they are typically clear water lakes with low nutrient levels (1-10 µg/L TP), sparse plant life (0-2 µg/L Chl. *a*), and low fish production. Lakes of high productivity are ***eutrophic***. They have abundant plant life (>7 µg/L Chl. *a*) including algae, because of higher nutrient levels (>30 µg/L TP). Lakes with an intermediate productivity are called ***mesotrophic*** and have moderate nutrient levels (10-30 µg/L TP and 2-7 µg/L Chl. *a*) and generally combine the qualities of oligotrophic and eutrophic lakes.

Water Clarity

As mentioned in the previous section, one method of determining productivity is water clarity. The more productive a lake is, the higher the algal growth, and, therefore, the less clear the water becomes. The clarity of the water can be evaluated by using a Secchi disk, a black and white disk that measures the depth of light penetration.

As the figure below shows, Langford Lake water is clearer in some years than others, likely as a result of water and nutrient inputs during years of higher run-off, grazing by zooplankton like *Daphnia* and mixing events when nutrient rich bottom waters are mixed into surface waters of the lake. A

trend of improving clarity appears to be taking place from the mid 1980's to recent sampling dates, with the maximum reading of 8.5m recorded on August 18, 2004.

Phosphorus

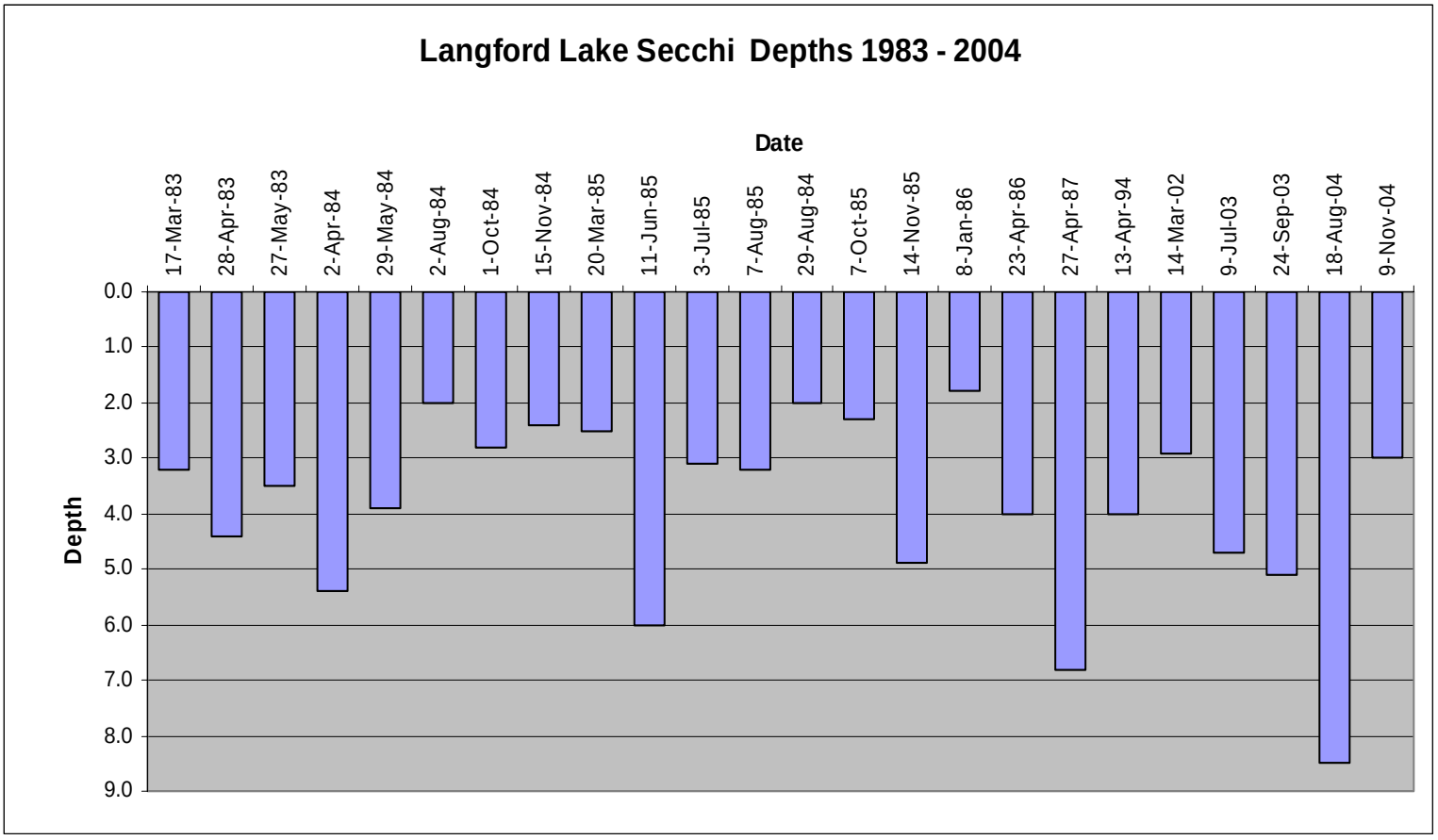
As mentioned previously, productivity can also be determined by measuring nutrient (i.e. phosphorus) levels and chlorophyll *a*. Phosphorus concentrations measured during spring overturn can be used to predict summer algal productivity.

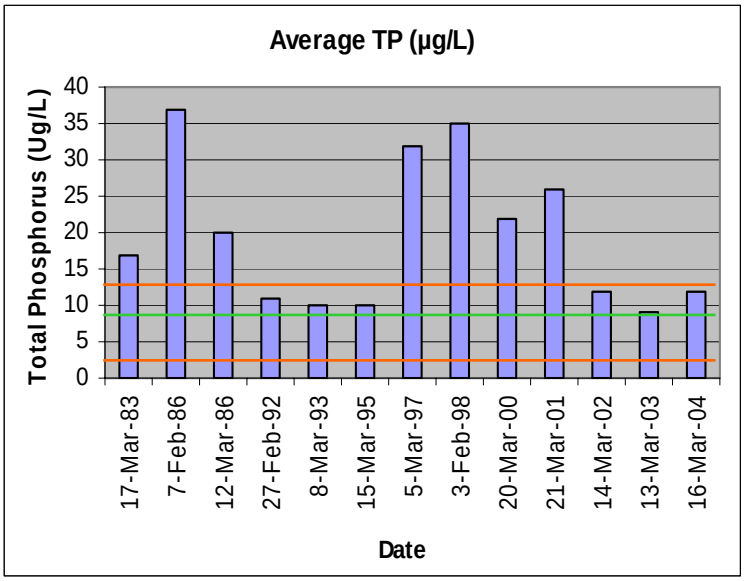
In most lakes, including Langford Lake, phosphorus is the nutrient in shortest supply and thus acts to limit the production of aquatic life. An increase in phosphorus can result in an increase in algae and a decrease in water clarity. Algae provide food for zooplankton (tiny animals floating in the water column) that are, in turn, food for other organisms, including fish, but can cause problems within a lake such as reduced water clarity, fish kills, and taste and odour concerns for drinking water use.

Lake sediments can themselves be a major source of phosphorus. If deep-water oxygen becomes depleted, a chemical shift occurs in bottom sediments. This shift causes sediment to release phosphorus to overlying waters. This *internal loading* of phosphorus can be natural but is often the result of phosphorus pollution. Lakes displaying internal loading have elevated algal levels and generally lack recreational appeal.

The amount of phosphorous in a lake can be greatly influenced by human activities. If local soils and vegetation do not retain this phosphorus, it will enter watercourses. In most lakes, phosphorus accelerates growth and may artificially age a lake. Cultural eutrophication has been a long standing issue for Langford Lake and to address this in the past, agricultural runoff was diverted and the aerator was installed.

As shown in the following graph, phosphorus sampling in Langford Lake was done prior to March 31st each year to ensure the readings were taken prior to stratification of the water column. Total phosphorus levels in surface waters of the lake appear to be in the mesotrophic range. The green line indicates highest acceptable level of total phosphorus for recreational activities, and red lines indicate the acceptable range for aquatic life. The total phosphorus concentrations in Langford Lake have generally been within the aquatic life guidelines since 1992 but there have been periodic exceedances which may be cause for concern. In addition, the total phosphorus guidelines for recreational use have seldom been met, although it should be noted that there have been several years where the data was not available.





Total Nitrogen

Nitrogen is an important nutrient in the biological production of aquatic environments. However in most BC lakes, nitrogen is second to phosphorus as the most limiting nutrient. Overall, in Langford Lake, all forms of nitrogen are in low concentrations and have decreased since 1984.

The Ministry of Water, Land and Air Protection has been collecting water quality data on Langford Lake since 1973. Prior to 1984, Langford Lake had high nutrient levels during summer stratification. Most chemical and physical water quality parameters measured in Langford Lake are now at acceptable levels; however, as stated in this document, some issues have been identified.

Should Further Monitoring Be Done on Langford Lake?

Local concerns have been expressed regarding potential future water quality issues that may arise from future development within the catchment. Given the recreational values of the lake and potential for future development within the watershed, the Ministry of Water, Land and Air Protection is planning a thorough water quality assessment to be undertaken in 2005. This assessment will include monitoring the physical, chemical and biological aspects of the lake and documenting the current condition of Langford Lake's water quality.

The Langford Lake Area Protection Society (LLAPS) has volunteered to assist with this monitoring under the BC Lake Stewardship and Monitoring Program. The LLAPS is a non-profit organization, incorporated in October 1995, dedicated to protecting Langford Lake and semi-rural ambiance of the community of Langford.

In addition to a formal MWLAP report documenting the results of the 2005 water quality assessment, the ongoing monitoring results collected by LLAPS will be summarized in future lake specific documents written for residents of the watershed.

Tips to Keep Langford Lake Healthy

Yard Maintenance, Landscaping & Gardening

- Minimize the disturbance of shoreline areas by maintaining natural vegetation cover.
- Minimize high-maintenance grassed areas.
- Replant lakeside grassed areas with native vegetation.
- Do not import fine fill.
- Use paving stones instead of pavement.
- Stop or limit the use of fertilizers and pesticides.
- Do not use fertilizers in areas where the potential for water contamination is high, such as sandy soils, steep slopes, or compacted soils.
- Do not apply fertilizers or pesticides before or during rain due to the likelihood of runoff.
- Hand pull weeds rather than using herbicides.
- Use natural insecticides such as diatomaceous earth. Prune infested vegetation and use natural predators to keep pests in check. Pesticides can kill beneficial and desirable insects, such as lady bugs, as well as pests.
- Compost yard and kitchen waste and use it to boost your garden's health as an alternative to chemical fertilizers.

Auto Maintenance

- Use a drop cloth if you fix problems yourself.
- Recycle used motor oil, antifreeze, and batteries.
- Use phosphate-free biodegradable products to clean your car.
- Wash your car over gravel or grassy areas, but not over sewage systems.

Onsite Sewage Systems

- Inspect your system yearly, and have the septic tank pumped every 2 to 5 years by a septic service company. Regular pumping is cheaper than having to rebuild a drain-field.
- Use phosphate-free soaps and detergents.
- Don't put toxic chemicals (paints, varnishes, thinners, waste oils, photographic solutions, or pesticides) down the drain because they can kill the bacteria at work in your onsite sewage system and can contaminate waterbodies.
- Conserve water: run the washing machine and dishwasher only when full and use only low-flow showerheads and toilets.

Boating

- Do not throw trash overboard or use lakes or other waterbodies as toilets.
- Use biodegradable, phosphate-free cleaners instead of harmful chemicals.
- Conduct major maintenance chores on land.
- Use absorbent bilge pads to soak up minor leaks or spills.
- Check for and remove all aquatic plant fragments from boats and trailers before entering or leaving a lake.
- Do not use metal drums in dock construction. They rust, sink and become unwanted debris. Use Styrofoam or washed plastic barrel floats. All floats should be labeled with the owner's name, phone number and confirmation that barrels have been properly emptied and washed.

Who to Contact for More Information

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Capital Regional District Natural Areas Atlas
(www.naturalareasatlas.ca)

Bathymetric Map:
FishWizard (www.fishwizard.com)

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